COMMENTS ON BEAMS FOR TARGET STATION NO. 2

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I. SS-37 BEAM MIX FOR TARGET STATION NO. 2

This seems like a very desirable and essentially sound design. Given finite resources and technique, the optimum possible design is probably a very soft maxima, i.e., any perturbation of angles, beams, etc. is likely to simultaneously introduce advantages and drawbacks which largely cancel. Nevertheless, I would like to propose one modification and arguments for it.

Switch the Roles (and Transport Systems) of the 2.5 mrad and 3.5 mrad Beams

The smaller angle beam has the intrinsically higher flux capability. Let us review the arguments for large flux allotment to each of these beams. The claim for higher flux by the high intensity serial, low resolution beam seems stronger to me than that of the high resolution beam.

1. The claim for high flux on the part of the high resolution beam seems very simply motivated. High resolving power in the transport system (small Δp) calls for large flux.

But consider the consequences of the design. The positive beam (dominantly protons, particularly at high energies) has a flux of 2×10^{10}/pulse - 3×10^{12} interacting protons. We do not know how to use counters in such a beam. What then is its likely disposition? To generate tertiary beams with this proton flux would seem to refute its high resolution character. p-p missing mass work is indeed possible, but the scope of this sort of experiment seems quite circumscribed, and it is by no means clear that this flux is necessary or even desirable. Perhaps polarization experiments will be the largest claimant on flux.

The negative beam intensity is presumably a few $\times 10^{6}$/pulse. Spectroscopy with π^-, K^-, and $\bar{p}$ would appear to have more scope than the proton spectroscopy alluded to above. However, electronic particle detection in the primary beam is probably desirable. If this is true, then fluxes greatly in excess of 10^{6} are of questionable value. Furthermore, the necessity for a beam transport with high resolving power is probably not essential. For electronically countable beam intensities, it is perfectly feasible to have lower acceptance, supple-mented by beam hodoscopes with arbitrarily fine-grained elements.

In short, I don't think that high resolution beam experiments are likely to be compromised by somewhat lowered flux, particularly if the flux can be recovered by reducing the magnetic resolving power and using hodoscopes.

2.   High Flux Beam. I suspect that this will be the most heavily subscribed beam. Presumably, a large role will be the production of tertiary beams. Obvious possibilities include

1. $\mu^{\pm}$ beams

2.   hyperon beams

3. γ and K^O beams with a low intensity neutron component.

This, presumably, is produced by using a negative beam.

Honesty compels me to make the following remarks concerning 3. This is not the <u>only</u> conceivable way to reduce a neutron component in a K^O beam. I trust that there will exist one or two small angle neutron beams off the primary target. Such a beam will have a much higher flux capability than the tertiary beam of 3. Neutrons can be depressed using a LiH filter and noting that the $K^O N$ cross section is about half that of the N-N cross section. Nevertheless, option 3 should be kept open.

As time passes, other schemes with flux requirements will undoubtedly be presented. For example, suppose it is highly desirable to deliberately introduce a very fine-grained rf structure into a tertiary beam by "wobbling" the secondary beam with deflectors, beam flux would then be an important consideration.

In summary, I think the highest and most flexible flux capability should be provided for that beam which would appear to provide the most varied prospects for experimentation.

II. SECONDARY NEUTRAL BEAMS FOR TARGET STATION NO. 2

It seems essential to provide some neutral beam capability in the general design of target station 2. It is already possible to visualize a large and diverse program of neutron and K_L^o physics using the very highest energies which will be available. Although I should enjoy setting forth various ideas concerning these, I shall not do so here. Rather let me expound the following points:

1. On a <u>relative</u> scale the construction and outfitting of such beams is cheap, i.e., relative to any of the charged particle beams.

2. There should be <u>two</u> small angle beams constructed. They will of necessity pass through the muon beam shield. Thus, their design will depend intimately on the nature of this shield. Neither the choice of earth nor dense material such as Fe and/or concrete precludes neutral beams. Considering the magnitude of the muon shield, it would be unwise to install or seriously modify such neutral beams after the fact.

(Furthermore, it would be wise to initiate studies to consider the desirability of providing other kinds of facilities imbedded in the muon shield. Snap judgments are to be avoided. Perhaps a case can be made for providing a channel suitable for the extraction of muon beam from the hadron shield. The Adair and Lederman groups who have performed beam dump experiments at the AGS could perhaps aid in this.)

The 2 neutral beams alluded to above should have different production angles, e.g., 2.5 mrad and 15.0 mrad. The former would be largely (but not exclusively) earmarked for neutron work while the latter would mainly serve K^O work and possibly γ experiments.

3. One of the most compelling arguments for 2 beams is the fact that the cost of 2 beams would be <u>considerably</u> less than <u>twice</u> the cost of one. Note that a 2.5 mrad beam and a ± 15.0 mrad are separated by 12.5 or 17.5 feet at a distance of 1000 feet. This would appear to be adequate experimental separation and yet the two beams could share a common experimental building.

4. It seems reasonable to have each of the two beams share the hadron shield collimators of the proposed charged particle beams. Hence, the choice of 2.5 mrad and 15.0 mrad. The charged beam bending magnets then provide a neutral beam sweep. Such a procedure has already been realized in the cases of the 4° and 20° neutral beams at the AGS.

Arguments for choosing production angles different from these are not, to my mind, compelling. It can be argued that a smaller angle beam (~ 0.5 mrad would yield a monochromatic spike of neutrons from p-n charge exchange. Extrapolating from existing data, such a spike would be even narrower than a diffractive scattering distribution and <u>considerably</u> smaller in size. Such a spike will likely be so small as to make its exploitation problematic. The "white" spectrum of neutron

energies is what we will have to deal with. Even if full machine

energy neutrons were exploitable, experimental data would thus be

provided at a single energy. That the machine energy will be system-

atically varied in deference to the neutral beam as prime user does

not seem likely or even desirable. These remarks are, of course,

debatable.

Beam angles wider than 15.0 mrad would seem to conflict severe-

ly with the charged particle beam facilities. Perhaps a case can be

made for beams in the 100-200 mrad range. This is another story.

Such beams would not provide the high energy fluxes envisaged here

and should be regarded as supplemental, not replacements.

5. We should remind ourselves that the K^O/n^O ratio of a beam is

somewhat controllable. By using a light element filter, e.g. LiH, we

can exploit the fact that the NN cross section is almost twice the $K^O N$

cross section. There will be ample flux available to permit heavy

filtering.

6. Let us list the essential components of these beams.

a. Vacuum pipe

Length ~ 1000 feet, possibly longer.

Note, for example, that the mean free path for K^O_L decay

is 1000 feet for a 10 BeV/c K^O_L. The hardening of the K^O_L beam

by decay in flight of K^O_L of low energies is probably desirable.

b. <u>Initial collimation and magnet sweep</u>

This is provided by the charged beam arrangement. The physical separation of the neutral and charged particle beams provides an engineering problem. Compromising the charged beam optics is clearly undesirable. Perhaps, one would deliber-ately exclude that 15.0 mrad beam which is outfitted with rf separators from consideration as a neutral port.

c. <u>Experimental area.</u> Magnet, utilities, etc. A final colli-mator and experimental shield are probably necessary.

d. <u>An intermediate collimator and sweeping station.</u>

This would be a tunnel or structure of limited size and access. A length of 50 feet - 100 feet seems desirable.

This would be the primary place to control the beam dimen-sions. Fe, Cu, W, or U collimation would be aligned here. Something like 40 kG-m of sweep seems desirable.

Remotely controlled filters and transmission samples would presumably be placed here.